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# THE FUTURE OF THE TROPICS.

BY DR. P. CHALMERS MITCHELL.

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THE movements of human beings on the surface of the earth are directed by needs and limited by conditions similar to the circumstances that determine the distribution of other animals. In the past, man multiplied in his original home, wherever that may have been, and spread from it, conquering or being turned by similar physical and climatic obstacles, being repelled or attracted by similar favorable or unfavorable conditions. At the present time, the great mass of the human population of the earth occupies temperate regions. The Arctic regions support a scanty and scattered population of wandering tribes. The large tropical land-masses, continental or insular, are relatively sparsely peopled, and the distribution is thickest around the coasts. From the time at which history began to be written in fossil remains, in buried weapons and implements, in folk-lore and traditions, man has been a creature of temperate maritime lowlands. Along the shores of temperate seas, in river valleys and deltas, the conditions of life have been most varied and favorable, food has been most abundant, the struggle for existence has been most severe, and the highest types and the great civilizations have been developed.

We do not know in what part of the world or even in what geological horizon it would have been possible to draw the first line of division between man and the man-like apes from which he came, but the obvious conditions of present distribution point to a temperate place of origin, from which man has spread. The presence of modern anthropoid apes and of so many of the lower types of humanity in the tropics to-day, does not decide their place of origin. The existing anthropoids and the most primitive living savages are separated from the common ancestors of

man and the apes by as long a gap in time, and by at least as many generations, as are the highest types of modern civilization. They may have been left behind in their original homes, or, more probably, they may have been driven into the tropics by more prosperous rivals. But there is no doubt that modern civilized man, now and for long characteristically temperate, is pressing towards the tropics, sometimes with the languid ambition of "pegging out claims for posterity," sometimes with the fierce activity of war.

The first difficulty, and one that seems hard to overcome, depends on the direct physical condition of climate. There is no doubt that at present the higher white races do not easily establish themselves within the tropics, if by establishment is meant not merely successful individual life, but the founding of families. No conclusion of Zoology seems more certain than that the land-population of the earth arose from inhabitants of the sea. The lowly newt-like ancestors of the higher terrestrial creatures slowly through the ages crept from the salt marshes, inland to plains and forest and hills, diverging as they went into lizard and snake, bird and mammal. They were at first cold-blooded, or, to put the biological fact more accurately, the temperature of their bodies varied with the temperature of the surrounding media, following the changes almost as closely as a sea-weed follows the changing temperature of the water in which it floats. The transition from the equable temperature of sea-water to the air on the land, with its swift and severe diurnal, seasonal and irregular rises and falls, must have been difficult to overcome; and it was probably under the stimulation of this new difficulty that there arose mechanisms by which the temperature of warm-blooded animals is kept at a level independent of the external fluctuations. In the early days of terrestrial life and, probably, for long after it had been established, a narrow area of the coast line, in the warmer temperate and colder tropical parts of the globe, contained all the land population. In such regions, the descent of winter had fewer terrors, and even these might be avoided by resort to the marshes, and summer had a less cruel alternation of heat of noon and cold of night.

To such regions, man, up to the present, has confined his greater successes; but there is nothing in the nature of things to prevent the higher races from following the example already set

by some of the lower and becoming adapted to the extremes of tropical climate. It is merely an extension of the capacity for adaptation already displayed by the whole vertebrate series when they passed from water to land. Even at the present time, civilized white races are accustomed to undergo sudden changes of temperature amounting to thirty or forty degrees, as when they pass from the warm air of a house to the cold of a winter's day. They suffer this with practically no risk to health and little to comfort; for there exists in all of us a delicate nervous and vascular mechanism by which heat-production and heat-dissipation are adjusted automatically to the changes of the environment. We all know, moreover, that it requires very slight training to extend the convenient limits of this automatic adjustment, so that not the smallest change of clothing is needed for the transition from outdoors to indoors. Here, then, lies ready material on which selection may operate: a bodily mechanism varying in individuals and capable of considerable improvement by use. It cannot be doubted that selection, conscious or natural, might produce, in a very few generations, a variety of the civilized white races completely adapted to the exigencies of the tropics. In the natural course of events, the new habit would be acquired in a great continental area, like America or Africa, where continuous land-masses stretching from the temperate to the tropical zones afford the opportunity for slow, gradual transition.

A second and graver reason seems to make the tropics only an inhospitable and temporary host of white man. A multitude of subtle enemies rise up against his invasion. The odorous depths of the jungle, the green and purple swamps, the dim recesses of the forest, and the fiery, open plains, all breathe poison on him. Black fevers, yellow fevers and malarias seem to rise from the ground against him; diseases of the liver, diseases of the blood, diseases of the skin oppress him; the citadel of his health is stormed at every gate; and, if he escape at all, it is with a broken and enervated vitality. However scrupulously exaggeration be stripped from such a presentment, there remains a forbidding truth; and yet, on a wider survey, the difficulties fade away.

The first important consideration to be weighed is that the tropics have no monopoly of unfriendliness to man. Natives of the central tropical belt, brought to England or to the northern part of the United States, meet conditions extremely unfavorable

to them. A different set of scourges meet them on our shores; the most dangerous of the tropical lowlands are no more truly the white man's grave than old England is the grave of the black man. Tubercles and pneumonias, rheumatic fevers and influenzas, and a host of diseases endemic in the crowded cities of the temperate zones are ready for him. Sometimes, indeed, a white man's disease has broken loose from the white man's home, and has left a broad track of death in its trail across the tropics. The presence of the white man has proved fatal to many a savage race; and this because there come with him the seeds of many diseases inconsiderable to him but fatal to the savage.

The common feature of all these diseases is that the exciting cause is some kind of living parasite, in most cases the small plants we know as bacteria. These microbes were not originally parasites, but lived a free life in water or mud. They were different in different regions of the world, just as other plants and animals differ, and those that have become human parasites in the tropics are different from those which have become human parasites in temperate regions. For countless generations, the members of the human race have been engaged in a life and death struggle, each with the microbes of its own locality. Different individuals differ in their inborn susceptibility to any particular microbe; and, in the course of generations, a continual elimination of the more susceptible individuals has made each race more able to repel the attacks of its local microbes. Most of us in England are now able to resist the attacks of the tubercle bacillus, although probably none of us escapes infection by it; in the same way, a large proportion of the Gold Coast negroes resist the attacks of malaria, although probably all are infected by it. On the other hand, subject these negroes to the English conditions of omnipresent tubercle and the majority will succumb, just as the majority of Englishmen fall before the tropical fevers. There is no reason, given time and opportunity, why white races should not adapt themselves to resist the alien diseases of the tropics as well as they now endure their own diseases.

Selection and destructive elimination, no doubt, will play an inevitable and cruel part in this business of race modification; but there is more than ground for the hope that direct methods will assist in gaining victory over tropical diseases. In the old days, the memory of which has still left traces in our invocations,

the incidence of disease was regarded as the direct operation of an inscrutable Providence, to be averted, perhaps, by prayer and humiliation, but otherwise beyond human control. We know now that most diseases come as directly from living seeds as the harvests of Autumn come from the grains planted in Spring, and the knowledge begins to bring with it power of control. The most recent and useful advance in knowledge of disease is the discovery of the life-history of the malaria parasite. The active agent in malaria is a minute organism that, in one phase of its life, lives and multiplies in the red corpuscles of human blood. It passes another phase of its existence within the bodies of mosquitoes, and it is by the bites of these that human beings are first infected with malaria, and that the infection is carried from person to person. Study of the habits of the disease-bearing mosquitoes of different regions has already led to the conclusion that a very simple crusade against mosquitoes, in their adult form, and during their larval life, would stamp out the disease. Malaria is the chief endemic disease of the tropics, and is by far the most serious barrier to white races. Dysentery and Beri-beri leprosy and the others are equally capable of being dealt with when the exact knowledge comes, and it cannot be doubted that the time is fast approaching when, partly by direct measures and partly by a slower selective acclimatization, white races will live as securely in the tropics as they now do in the temperate zones.

At the present time, the lures that draw men towards the tropics are numerous and none of them specially urgent. There is the spirit of adventure, the most elemental of the qualities that distinguish man from the brute, the spirit by which our savage ancestors tamed the dreadful demon fire, and which is implicit alike in the patient toil of the laboratory and in the aspirations of the philosopher. There is the quest for unknown natural products; woods and roots, spices and barks, strange and flaming blossoms, the jewelled plumage of birds, hides and horn and ivory. The noisome swamps may cover mines of gold and tin; there are diamonds and emeralds, sapphires and turquoises in the clays and gravels of the river beds. There are the abominations of heathendom to be suppressed; souls to be saved and weird translations of Western Dogma to be implanted. There is the Flag, the fetich of white races, to be unfurled in new regions, and there are trade gin and fishing dynamite to follow the flag.

The naturalist, the sportsman, the hunter, the orchid collector, the missionary, the soldier and the trader alike seek the tropics, but all share the same hope of returning.

These individuals, urged by inconsiderable motives, are only the vanguard of a great movement of the white races towards the sun. Nothing is more probable than that, at a time not unthinkable remote, the white races will struggle as arduously and as fiercely for possession of land under the burning sun of the equator, as, in the past, they have fought for the temperate zones. Race-pressure, the inevitable and primordial expansive force of multiplying organisms outgrowing their geographical limits, will prove the fundamental stimulus, and, at first, will guide the movement towards the tropics, for the simple reason that thither is the line of least resistance, leading to habitable parts of the earth least occupied by whites. But later on, another reason will orient the movement more certainly and greatly increase its force. This ultimate cause lies in the nature of life itself.

Viewed simply, and without metaphysical subtlety, all the phenomena of life, and among them the activities of the human race, are transformations of energy. The economical system of the world hinges on the sources of energy. So far as human beings are concerned, the important sources are food and fuel—food, the metabolism of which within the body provides for the individual activities, and fuel, the metabolism of which in mechanical appliances provides for all the arts and industries by which civilized man surrounds himself with an artificial but now necessary environment. There are two ways of meeting necessary expenditure; direct income and drawing on capital. In the case of fuel, the world possesses vast stores of capital, accumulated ages before the arrival of man. Even in England, there is a supply estimated to last, at the present rate of depletion, for several centuries; and in the world as a whole the discovery of new coal-fields and oil-beds proceeds apace. Moreover, the increase of physical knowledge has made the use of fuel less wasteful, and there is a constantly diminishing difference between the potential energy of any mass of oxidizable material and the actual energy obtained from it; a state of affairs which retards considerably the rate of destruction of capital. Altogether, there does not seem much reason to suppose that a time will arrive soon when humanity has to revert from the capitalized fuel of the

world to the daily income of solar heat. If such an event should come, its approach will be heralded by vast changes, and it is almost impossible to predict its effect on the distribution of population.

On the other hand, the reserve of food is so small that the world may be said to live almost directly on its income. There is no doubt as to the nature of this income of energy. The food of man, like the food of all living things, in whatever form it enter the tissues, consists of water, certain extremely common mineral salts, and the substances known chemically as carbohydrates, such as starch or sugar, and proteids, such as albumen or gluten. Considering food simply as the source of the energy of life, we may neglect water and the mineral salts as accessories, however necessary, and proteid, because that substance, in so far as it is a source of energy, raises no question that is not more simply dealt with in the case of carbohydrates. We are left then with these compounds of carbon, hydrogen and oxygen as the vehicles by which potential energy reaches the living organism.

As natural products, these occur only in the bodies of living animals and plants, or in substances immediately derived from living things. Carbohydrates do not occur in sea-water or in fresh-water, in rock-deposits or in clays and sands; so far as our knowledge of terrestrial things goes, carbohydrate material is always associated with life. Animals obtain it by feeding on other animals or on plants; man, like other animals, gets it from flesh and grains and fruits; fungi obtain it from animal and vegetable matter alive or dead. All these, to provide for the energy of life, destroy a proportionate bulk of carbohydrate, reducing it to simple inorganic gases and vapors, precisely in the same fashion as a piece of machinery destroys a bulk of fuel, in a proportion to the work it performs determined by its mechanical efficacy. The only living things that add to the mass of carbohydrate material in the world are green plants; all other life is parasitic on green plant life, vegetarian animals directly, flesh-feeders indirectly by living on vegetable feeders. Life, in all its wonderful manifestations, in its highest and in its lowest forms, depends directly on green plants, on the innumerable microscopic *algae* of fresh-water and sea-water, on the grass and foliage that cover the hills and plains with a mantle of green. The explanation of this dependence is simple and universal. Green plants are the means



by which there is captured for use the radiant energy dancing across the void from the sun to the earth. Dissolve some of the green coloring matter of plants in alcohol, and pass a beam of sunlight through the solution; the simplest physical experiments will show that the beam, on emerging, has lost heat-rays, chemical-rays and light-rays; energy has been taken from it. The same process occurs in living green plants, and, from the point of view of the vital economy of the world, their manufacture of carbohydrates is no more than a storing, as potential energy, of the radiant energy of sunlight.

Science is already doing much to increase the rate and the total amount of this absorption of energy. Every improvement in tilling the soil, in applying rightly the right chemical foods, in draining and in watering, adds to the amount captured. Still more efficacious are the improvements made in plants themselves by artificial selection; the production of new varieties with more rapid growth, with heavier grains or fruits, simply means that the intelligence of man has brought about the possibility of capturing a greater proportion of the energy bestowed by sunlight in a given time and area. It is possible that science may advance beyond the culture of plants to the supersession of plants by direct chemical agencies. There are innumerable modes in which sunlight may be made to do chemical work, and so to store up potential energy; chlorophyll itself may be synthesized, or simpler pigments with comparable physical properties may be prepared, and carbohydrates may be manufactured directly, on a large scale and in a form suitable for food, without the intervention of the tedious processes of the vital laboratory of leaves. The greatest conceivable progress in scientific husbandry, and the most stupendous inventions to replace plants, however, would only bring to an exacter issue the ultimate question. Sunlight, and sunlight alone, is the permanent income of the world, and the human race is living more and more closely up to its income. Precisely as the means for securing this income grow more exact, and as the world grows more directly dependent on them, the parts of the earth where the income is greatest will grow most valuable. Not for gold nor for diamonds, nor for the fat soil of volcanic slopes will be the future battle of the nations; but for that belt of the globe on which most lavishly radiant energy comes to us from the centre of our Cosmic System. P. CHALMERS MITCHELL.